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Article (Published Version)

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Production & Manufacturing Research

An Open Access Journal

ISSN: (Print) 2169-3277 (Online) Journal homepage: http://www.tandfonline.com/loi/tpmr20

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To cite this article: Nachiappan Subramanian, Muhammad D. Abdulrahman & Shams Rahman (2014) Sourcing complexity factors on contractual relationship: Chinese suppliers' perspective, Production & Manufacturing Research, 2:1, 558-585

To link to this article: http://dx.doi.org/10.1080/21693277.2014.949361

Published online: 18 Aug 2014.

Production & Manufacturing Research: An Open Access Journal, 2014
Vol. 2, No. 1, 558–585, http://dx.doi.org/10.1080/21693277.2014.949361

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Sourcing complexity factors on contractual relationship: Chinese suppliers' perspective

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(*Received 19 November 2013; accepted 24 July 2014*)

To reduce cost and gain competitive advantage, original equipment manufacturers (OEMs) around the world have continued their aggressive sourcing from China. However, sourcing in China has never been a straightforward process and OEMs face both tangible and intangible sourcing complexities with significant negative impact on both expected positive benefits and their contractual relationships with the Chinese suppliers. We developed sourcing complexity model using comprehensive literature review and multiple case studies in various industries to understand the suppliers' views on sourcing complexity in China. We employed Analytic hierarchy process technique to prioritise identified complexity factors and to derive managerial insights. Our results indicate that tangible complexity factors highly influence the Chinese suppliers' contractual relationship with OEM's. Number of suppliers available to OEM's to procure a component is identified as a primary dominating tangible factor, while differentiation in technical capabilities and operational practices between OEMs and suppliers represents the second biggest issue for Chinese suppliers in establishing contractual relationship with OEM's.

Keywords: complexity; contractual relationship; sourcing complexity; suppliers; China

1. Introduction

In the past two decades, low-cost or emerging country sourcing has continued to attract the attention of worldwide businesses and researchers. China is well-known as the 'global factory' due to its high manufacturing and assembly activities. Interestingly, it is less known to the external world that 76% of leading global firms products/components are sourced from China and it remains as the highest business activity in China (PwC, 2012). By sourcing from China, original equipment manufacturers (OEMs) gain unique competitive advantage through one of the following (i) materials cost reduction, (ii) labour cost, (iii) component service cost, and (iv) capital investment cost (Lau & Zhang, 2006; Najafi, Dubois, & Hulthen, 2013). There are additional motivations for OEM's such as reduced end product prices and total cost of ownership (Salmi, 2006), establishment of strategic relationship with suppliers (Hultman, Johnsen, Johnsen, & Hertz, 2012; Millington, Eberhardt, & Wilinson, 2006) and the abundant market for their final products in China (Hultman et al., 2012; Nassimbeni, 2006; Najafi et al., 2013). The

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above motivations will be helpful to the OEM's supply chains if they have good business reliability with the Chinese suppliers with appropriate order lead time.

Despite acknowledged benefits of low-cost country sourcing, the practice is not without its downsides. Literature indicates several consequences from low-cost country sourcing process that includes lack of capable and experience service providers, lack of desired quality standards, product piracy and supply bottlenecks, local regulations, and lack of overall post-outsourcing assessment difficulties, amongst others (Lanza, Weiler, & Vogt, 2010; Lau & Zhang, 2006). Sourcing supply chains are subjected to numerous other challenges such as dependency on few suppliers, inability to react to uncertainties, type of relationship, preferred channel type, and various other constraints. In fact, Horn, Schiele, and Werner (2013) suggest that even the extensive cost savings associated with low-cost countries' sourcing does not come automatically. This is because, in addition to such extensive cost savings being often exaggerated, specific characteristics of low-cost country supply chains have significant impact on the operational performance of the supply chain that decreases the much sought-after positive effects (Fredriksson & Jonsson, 2009; Horn et al., 2013). Even more troubling to sourcing managers is the prospect of what Horn et al. (2013, p. 35) termed the 'ugly twin' of failed low-cost country sourcing projects in which the sourcing firms are left with no choice but to reverse back to established suppliers from high-wage countries at a higher cost for each failed low-cost country sourcing project.

The above issues clearly demonstrate that sourcing process is highly complex, having varied interacting elements, and require a well-thought-out strategy to overcome such inherent complexities. While previous studies have highlighted the complexities in sourcing from low-cost country with respect to OEMs' perspective (Choi & Krause, 2006; Hultman et al., 2012; Yeniyurt, Henke, & Cavusgil, 2013). The study by Salmi (2006) analyses Western purchasing in China to establish the motives for sourcing in China, in addition to their specific requirements and the features of supplier relationships. Horn et al. (2013) examine the operational and financial implications and real effect of cost-oriented sourcing from China based on European automotive OEMs. The study reveals the decision-making pattern of OEM purchasing managers is solely based on standard practices of low-cost country sourcing projects in China. It is also evident from their study that most of the Chinese sourcing projects did not meet their expected benefits. Moreover, the previous studies failed to look at the complex issues encountered that resulted in negative benefits of Chinese sourcing process. To the best of our knowledge there are no studies to understand other side perspective i.e. what suppliers think about sourcing complexity factors. Without understanding both perspectives it is difficult to achieve a swift reorientation of supply chains and to remedy failures aspects (Kalyar, Sabir, & Shafique, 2013).

Firms within supply chain are interested in prioritising the complexity factors and are keen to address the dominant factors rather than addressing all the factors. Hence one among the popular prioritising methods i.e. Analytic Hierarchy Process (AHP) proposed by Saaty (1980) is employed in this study. This study develops tangible and intangible complexity factors hierarchy model based on multiple case studies of key industries of the Chinese manufacturing sector and estimates the priority weights of factors using Expert Choice® software. Our objective is to prioritise the complexity factors from the suppliers' perspective and not to rank the suppliers based on the factors. There are few attempts made so far to understand complexity in supplier buyer integration, domestic suppliers integration from buyers perspective, complexity, and adaptivity in supply networks, postponement in supply chain risk management (Lockstrom, Schadel,

Moser, & Harrison, 2011; Pathak, Day, Nair, & Kristal, 2007; Yang & Yang, 2010). To best our knowledge, this study is amongst the first to highlight complexity factors and its impact on suppliers solely based on suppliers perspective rather than conventional way of looking it from the buyers.

The rest of the paper is structured as follows: Section 2 provides brief reviews of related literature on sourcing complexity in China followed by Section 3 which explains the complexity factors with details on the tangible and intangible factors considered in this study. Section 4 discusses the detailed research methodology employed in the study. Section 5 provides the results and discussion while Section 6 summarises the findings of the study.

2. Sourcing complexity in China

Sourcing complexity refers to 'how the members of a system (e.g. suppliers in a supply base) vary and interact with one another (Choi & Krause, 2006, p. 638).' A number of studies have highlighted the impact of sourcing complexities on global supply chain (Nassimbeni & Sartor, 2007; Ngai, Chau, & Chan, 2011; PwC, 2012; Yeniyurt et al., 2013). Importantly, Choi and Krause (2006) opined that the degree of sourcing complexity has impacts on the transaction costs, supply risk, supplier responsiveness, and supplier innovation. With respect to China, Nassimbeni and Sartor (2007, p. 334) explain that sourcing from China entails overcoming a number of complexities that include 'language, cultural and geographic distance, coordination of an international logistics network, transfer of technological capabilities and managerial praxes, and quality monitoring at source.' While report by PwC (2012) emphasises the complex nature of Chinese import and export regulations in addition to quality and delivery reliability. In their study, Horn et al. (2013, p. 34) stated that 'three quarters of the China-sourcing projects do not reap the expected benefits.' Table 1 provides a summary of the key complexity terminologies.

Despite these complexities and potential poor financial performance, however, sourcing from China seems to be an attractive option for multinational corporations and big brand companies all over the world. For example, WalMart, the US multinational retail corporation, has the lengthiest and most successful supply chain of more than 10,000 suppliers in China (Dauvergne & Lister, 2012). According to PwC, over 75% of German companies it surveyed source 84% of their automotive products from China (PwC, 2012). In fact, Nassimbeni and Sartor (2007) noted that risks and complexities

Table 1. Complexity terminologies.

Term	Definition
System	A collection of inter-related elements that acquires resources from outside, transforms them, and delivers the products back to the outside
Complexity	The degree of varied elements and their interactions within a system
Supply network	All inter-connected companies that exist upstream to any one company in the value system
Supply base	A portion of the supply network that is actively managed by the focal company through contracts and purchasing of parts, materials, and services
Supply base complexity	The degree of differentiation of the focal firm's suppliers, their overall number, and the degree to which they inter-relate

Source: Adopted from Choi and Krause (2006, p. 638) and Thompson (1967).

will not hinder the strong sourcing appeal from China, as the country remain the number one foreign direct investment destination in the world. Multinational corporations (MNCs) try to manage the complexities in sourcing such as defective, toxic, and illegally produced products through proper policies and regulations using appropriate contracts with their suppliers. This is because effective managed procurement increases competitive advantage and enhances the value of supplier relationships, especially in the Western context (Deloitte, 2007). However, to source in China, few researchers have suggested that managers should have an expertise to deal with key cultural and social pillars of the society such as *Xinren* (interpersonal trust), *zouhoumen* (back door or corrupt practices) and *guanxi* (Connections and relationship build around exchange of favours) (Cheng, Yip, & Yeung, 2012; Gao, 2003; Liu, Yadong, & Liu, 2009; Matthyssens & Faes, 2006). It is interesting to notice that previous studies all emphasise the importance of relationship (*guanxi*) and trust (*xinren*) provide essential buffer against uncertainty and assistance when problem arise. Specifically, Cheng et al. (2012) found that sourcing firms will form *guanxi* networks with the key suppliers through proper communication and supplier trust if they perceive supply risk then it would lead to increased supplier performance. Matthyssens and Faes (2006) opined that deep trust (*xinren*) is critically important for successful sourcing transactions in China. Without significant visibility and control over sourcing process in China, the risk of back door or corrupt practices such as substandard and/or hazardous materials being used during production process, use of subcontractors and substandard facilities without buyers' knowledge, longer procurement chains, amongst other corrupt practices, are enormous (Deloitte, 2010). Such corrupt or back door practices have the potential for reputational harm as well as serious product legal liability exposures. There are few more institutions and policies concerns which subdues China's ratings in a number of key areas such as rule of law, intellectual property protection, flexibility, and regulations that enable risk taking and entrepreneurship (Kriz, 2010). Table 2 shows few studies which reports complexity issues related to sourcing from the Chinese context. Most of the previous studies are inductive case study oriented. The important complexity issues identified from these studies are both tangible and intangible in nature and includes issues such as quality, reduced visibility in operations, inter-relationship, cultural misunderstanding, regulations, coordination, infrastructure, employee training, tariff, and taxes, amongst others.

3. Process complexity factors

Process complexity refers to the supply base, the portion of a supply network being actively managed by the buying company (Choi & Krause, 2006). It consist number of suppliers, methods of supply, methods of cost calculation, differences in capabilities, several operational practices, and different modes of connectivity. Process complexities have both tangible and intangible elements. Tangible sourcing complexity factors are capable of being precisely identified or realised and appraised at an actual or approximate value. Tangible sourcing complexity factors have been categorised as including such factors as numerousness (i.e. the number of suppliers, various methods and channels of supply, number of interfaces, and systems) (Choi & Krause, 2006; Fredriksson & Jonsson, 2009; Kaluza, Bliem, & Winkler, 2006), We consider tangible process complexities as numerousness, differentiations, and number of interacting pairs, and level of inter-relationship (Choi & Krause, 2006; Kaluza et al., 2006). Few other intangible aspects are quality of product supply, decreased visibility in risk (Tse & Tan, 2012); inter-organisational collaboration (Ngai et al., 2011), relationship, and quality

Table 2. Complexity issues in sourcing from China.

Source	Aim of study	Method	Complexity/Issue	Tangible/ Intangible
PwC (2012)	Overview of logistic activities in China	Survey	Complex Chinese import and export regulations and quality of supply network	Tangible and Intangible
Tse and Tan (2012)	Vulnerability due to product quality risk in multi-layer supplier chain	Case study – single case	Quality of product Supply network. Decreased visibility in risk and operation processes	Tangible
Ngai et al. (2011)	Supply chain agility and supply chain competence and their impact on firm performance	Case study – multiple case	Relationship from the perspective of inter-organisational collaboration	Tangible
Marucheck, Greis, Mena, and Cai (2011)	Product safety and challenges in five main industries (food, pharmaceuticals, medical devices, consumer products, and automobiles)	Content analysis	Relationship and cultural misunderstanding	Tangible and Intangible
Han et al. (2011)	Investigated inter-firm exchange relationship and quality management in china pork supply chain through integrated transactional and relational governance perspective	Empirical analysis	Relationship and quality	Tangible
Wu and Pagell (2011)	Decision-making in sustainable supply chain management	Case study – single case	Regulations	Intangible
Lanza et al. (2010)	Interface between product design and production in low-cost countries sourcing	Case study – single case	Supply network, strategy, tariff and taxes, cultural aspect, cost for coordination and support, employee qualification and training, material requirement, long distances, and regulations	Tangible and intangible
Kriz (2010)	Highlights China's innovative past, present and future	Conceptual	Emphasise more on cultural aspects and innovation. Ranks low in policies and regulations	Tangible and intangible
Nassimbeni and Sartor (2007)	Analyses the sourcing types adopted by a sample foreign OEMs in China.	Case study – multiple case	Looked at language, cultural and geographic distance, coordination of an international logistic net, transfer of technological capabilities and managerial praxes, and quality monitoring at source	Intangible

(Han, Trienekens, & Omta, 2011). According to our classification Intangible process complexities factors include human capital, culture, infrastructure, policies, and regulations and it is based on sourcing characteristics suggested by Fredriksson and Jonsson (2009). Human capital complexity factors consist of supplier's skill, knowledge and

understanding of a workforce as the major elements (Kamauff & Speckman, 2008). Cultural aspects capture the contextual elements such as corruption, quality problems, language problems and criminality. It is well reported in the previous studies that it has substantial effect of material planning and forecasting (Ruamsook, Russell, & Thomchick, 2009). Soft factors related to infrastructure that inhibits sourcing in supply chain are opacity of sharing information, comparative price levels and establishing longer supply chains (Handfield & McCormack, 2005). Currency, supply risk, intellectual property protection, and dynamic customer requirements are influencing policies and regulations contextual issues in the emerging economies (Wu & Pagell, 2011). Details of the tangible and intangible factors considered in this study are shown in Table 3.

4. Research methodology

The case study investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2003). We used quantitative data derived through multiple case studies to investigate few aspects related to tangible and intangible factors of sourcing complexity. Following Eisenhardt's (1989) recommendation of four to ten as the number of cases

Table 3. Tangible and intangible process complexity factors.

Criteria	Sub-criteria	Details	Source
Tangible	Numerousness	Number of suppliers, various methods/channel of supply, and number of interfaces and systems	Choi and Krause (2006), Kaluza et al. (2006), Fredriksson and Jonsson (2009)
	Differentiations	Differences in technical capabilities and operational practices	Choi and Krause (2006), Fredriksson and Jonsson (2009)
	Number of interacting pair and level of inter-relationships	Different modes and number of interactions	Fredriksson and Jonsson (2009), Ngai et al. (2011), Marucheck et al. (2011)
Intangible	Human capital	Lack of skills and knowledge	Handfield and McCormack (2005), Fredriksson and Jonsson (2009), Tse and Tan (2012)
	Culture	Criminality corruption, quality problems, and language and cultural differences	Handfield and McCormack (2005), Nassimbeni and Sartor (2007), Song, Platts, and Bance (2007), Fredriksson and Jonsson (2009), Han et al. (2011)
	Infrastructure	Comparative price levels, opacity of sharing information, time zones, demarcating supply chains	Handfield and McCormack (2005), Fredriksson and Jonsson (2009)
	Policies and regulations	Currency, risk of supply, intellectual property risk, and dynamic customer requirements	Song et al. (2007), Kriz (2010), Lanza et al. (2010), Wu and Pagell (2011), PwC (2012)

that a researcher should select, we selected seven companies representing different industries within manufacturing sector such as automobile, electronics, food, plastics, footwear, fashion, and seat for our study (see Table 4). Given that a case selection should be guided more by its potential to help and contribute to the research objectives rather than by concern for randomness (Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002), these companies were selected based on their availability and willingness to participate. The selected firms are major suppliers to global brands making them more likely to be better aware of global best practices such as sourcing and procurement.

The case data were gathered mainly through interviews and authors' on-site observations. Data collection took place during September–October 2012. Interviews were semi-structured and conducted at the respective companies' sites. We had a questionnaire with two parts. Part A consisted of questions related to influence of tangible and intangible sourcing complexity factors with respect to contractual relationship. The questionnaire was developed based on a thorough review of the literature and was first tested with the Head of Unit and Senior Manager of two of the companies who have over six years at top management level. The feedback received helped the research team to refine the survey instrument and ensure its comprehensiveness. The final survey instrument requested the respondent to give their importance of factors for a pairwise comparison using Saaty's nine-point scale (Saaty, 1980). Part B had questions related to profile of

Table 4. Case companies' profile.

	Respondent and company profile					
Organisation sector	Position in organisation	Years of experience in reverse logistics & return management	Type of organisation	Age	No. of staff in reverse logistics & Return management	Type of certification
Automobile company ABC	Senior Manager	6	Joint venture	40	13	ISO 1400/ 1/2
Electronics company DEF	Senior Manager	7	Private	46	12	ISO 9000/ 01/02
Food packaging company GHI	Head of Unit	3	Joint venture	37	30	ISO 9000/ 01/02
Plastics company JKL	Assistant Manager	2	Joint venture	28	4	ISO 9000/ 01/02
Footwear company MNO	Director	7	MNC	26	9	ISO 9000/ 01/02
Fashion company PQR	Senior Manager	10	Private	48	7	ISO 9000/ 01/02
Seat company STU	Head of Unit	6	Private	27	5	ISO 9000/ 01/02

respondent and the organisation, as shown in Table 4. Additional questions were asked by phone, email, and follow-up interview was conducted with their respondents.

4.1. Chinese manufacturing sector

Aided by relatively cheap, dedicated, and skilled workforce, everything from toys, fashion goods, such as ladies handbags to cars and sophisticated electronic goods, are now produced in China. The significance of China's manufacturing sector can be comprehended by the country now being the 'global factory' and the world's largest automotive manufacturer and market (Horn et al., 2013). China's local automobile companies are increasingly working as part of joint ventures with leading global brands. This important trend predicts the likelihood of China to dominate in the development of the global automobile industry over the next decade. Pinto (2005) reported continual increasing manufacturing prowess, significant cost advantage (beyond just labour cost), and worldwide presence of made-in-China products with significant market share (5% of cameras, 30% of air conditioners and television, 25% of washing machines, and 20% of refrigerators). Similarly, China's plastics manufacturing sector employed 2.6 million workers and generated a total export value of US $14.40 billion in 2009. China's packaging market is the largest in the world and is predicted to grow to US $97 billion per annum by 2012 (Wood, 2010). Food packaging alone accounts for 50% of the total demand for packaging with volume growth more than 20%, being common in most food sectors. It is a similar story for China's footwear industry with the total export value hitting US $24 billion in 2009. These motivated our selection of seven case studies in China's manufacturing industries including, automobile, electronics, food packaging, plastics, footwear, fashion, and seat, to identify the influence of sourcing complexity factors and to learn how firms manage these issues.

4.2. Case companies' profiles

4.2.1. Automobile company ABC

The company is a leading manufacturer of tools sets, tools kit, spark plug wrench, oil filter wrench, ratchet wrench, and other accessories for automobile sector and located in Zhejiang Province. The company is a wholly locally owned joint venture with nearly 40 years of manufacturing experience. The company currently has about 15 dedicated supply chain and reverse logistics management employees, and annual revenue of USD 5 million. The company has an ISO 1400/1/2 standard and has many of the global automotive brands (GM, Ford, Toyota, Volkswagen AG, and DFAC) as its customers.

4.2.2. Electronics company DEF

The company is a leading manufacturer and exporter of various electronic lighting sensors in coastal city of Ningbo, Zhejiang Province, China. The products include: PIR sensor switch, M/W sensor switch, wireless remote control door bell, smoke alarm, and multifunctional wireless home security alarm systems, amongst others. The company currently has about 15 dedicated supply chain management and reverse logistics management employees. The company has over 20 years experience as an exporter of specialised sensor electronic systems. It currently employs over 300 lighting specialists. The company has an ISO 9000/01/02 standard and products are manufactured under quality standard of most products which have CE, GS, UL, BSI, and VDS approval.

4.2.3. Food packaging company GHI

The company is a leading manufacturer of packaging products for food and drug in coastal city of Ningbo, Zhejiang Province, China. The company specialises in food packaging pouch, medical disposable co-extrusion film, vacuum seal storage bag, and films, amongst others. The company has a world-class co-extrusion film blowing production lines in a 1900-square-metre workshop that meets the good manufacturing practice (GMP) standard. It is a joint venture company with more than 10 years of international business experience. The company currently has more than 21 dedicated supply chain management and reverse logistics management employees with about three years of experience in logistics, supply chain management (SCM), and return management. The company has an ISO 9000/01/02 standard.

4.2.4. Plastic company JKL

The company was established in 1997 and it specialises in designing and manufacturing moulds for company's local and international clients, and it is located Ninghai, Zhejiang Province, China. The company has a total staff strength of 128 of which eight are senior engineers, 16 are designers, 37 are moulding technicians, and 65 are high-skilled moulding workers. This joint venture company currently has about five dedicated supply chain management and reverse logistics management employees. The company is an ISO 9000/01/02 standard, and mouldings are manufactured to high quality British, American, HASCO, and D-M-E standards.

4.2.5. Footwear company MNO

The company specialises in the manufacturing and exporting of various beach slippers, flip-flops, indoor slippers, and children sippers, amongst others. It is located in Ningbo, Zhejiang Province, China. The company has an ISO 9000/01/02 standard, and about 60% of its products are exported mainly to Europe and USA. It has a total annual sales volume of USD 35 million. The company is an MNC and currently has about 10 dedicated supply chain management and reverse logistics management employees with between 4 and 7 years of experience in logistics and SCM.

4.2.6. Fashion company PQR

The company is a leading manufacturer and exporter of various ladies fashion handbags, cosmetic handbags, and backpacks in Ningbo, Zhejiang Province, China. The company currently has about 10 dedicated supply chain management and reverse logistics management employees, all of whom are university graduates with working experiences of between 8 and 10 years in the company. Each year, the company designs and produce around 1.5 million handbags with the entire outputs being exported to clients globally. The company is privately owned and has an ISO 9000/01/02 standard.

4.2.7. Seat company STU

The company is one of the pioneers and the fastest growing privately owned producer of baby car seats in Ningbo, China. The company is proud of having its products tested by the most authoritative agency, TNO laboratory, with an approval by ECE R44/04

certificate. The company has an ISO 9000/01/02 standard and currently has about five dedicated supply chain management and reverse logistics management employees, all of whom hold diploma qualifications.

4.3. AHP methodology

The AHP proposed by Saaty (1980) is a well-known robust multi-criteria decision-making (MCDM) technique for prioritising factors/alternatives, which is suitable for both qualitative and quantitative analysis. The AHP method has been applied in wide variety of areas including prioritising criteria, selecting a best alternative, resource allocation, and resolving conflicts (Hofmann & Knébel, 2013; Sipahi & Timor, 2010; Vaidya & Kumar, 2006). The AHP is mostly used for its effective and adequate means of capturing the independent effects of the different factors within a hierarchy in a MCDM process.

The choice of method used in any study depends on appropriateness and the objective of the study. Our objective is to capture the independent effect of the sourcing complexity factors in the decision-making process of the Chinese suppliers and to prioritise these complexity factors. The interactions and overlapping nature of these factors are better studied using Analytic Network Process (ANP) rather than an AHP. We recognised that, for instance, tangible factors, like 'Numerousness' and 'Differentiations', can have interacting effect on each other. Additionally, tangible factors, such as those mentioned above, can have interacting effect on intangible factors such as 'Human capital' of lack of skills and knowledge, and vice versa. To capture the interaction effect and interdependency, ANP is preferable to AHP.

However, the use of an ANP may make the model development process through interview too complex. For example, an ANP needs to compare the relative importance of each and all sub-criteria and alternatives both within and between clusters. Furthermore, the questionnaire for an ANP for the two criteria (tangible and intangible) with eight sub-criteria identified in this study will require asking managers to compare the relative importance of each sub-criterion. Given that this work is focused only on the hierarchical relationship between sourcing complexity factors and their relevant attributes, we reckoned that the complexities associated with ANP methodology would neither advance our objective nor motivate managers/policy-makers. Similar consideration may have informed recent studies in which AHP and not ANP are employed. ANP methodology is suitable to develop inter-relation among criteria and has a feedback to take care of uncertainty and dynamics. Since our study focuses on linear relationship with known static scenario, our intention is to capture the independent effects of hierarchical factors; hence, AHP is more suitable for our study. Furthermore, a study by Pohekar and Ramachandran (2004) found that AHP is the most popular MCDM method used in 90 published articles they analysed when compared with PROMETHEE and ELECTRE (Subramanian & Ramanathan, 2012). Recently, Charan, Madaan, and Khare (2012) used the AHP model for the selection of service supply chain value creating perspective, while Bruno, Esposito, Genovese, and Passaro (2012) used the AHP model for supplier evaluation. Hofmann and Knébel (2013) use AHP to examine manufacturing strategy selection changes when customer requirements vary. We, therefore, effectively chose the AHP based on its adequacy and effectiveness in satisfying the primary objective of this study, capturing the independent hierarchical effect of sourcing complexity factors on contractual relationship from the Chinese suppliers' perspective.

The application of AHP to a decision problem involves structured four steps (Ho, 2008; Ramanathan, 2006). In our analysis, we are prioritising the tangible and intangible sourcing complexity factors. Hence, we use first three levels as discussed below because fourth step is to compare the alternatives and prioritise suppliers, and our analysis does not include fourth step.

Step 1: Structuring of the decision problem into a hierarchical model

It includes decomposition of the decision problem into elements according to their common characteristics and the formation of a hierarchical model having different levels. Our AHP model (Figure 1) has three levels (two major levels and one minor level) influencing of sourcing complexity factors on contractual relationship as our goal, tangible, and intangible sourcing complexity factors as our criteria and four elements of tangible sourcing complexity (numerousness, differentiation, interacting pairs, and level of inter-relationship) and four elements of intangible sourcing complexity (human, culture, infrastructure, and policies and regulations) as our sub-criteria.

Step 2: Pairwise comparisons and the judgemental matrix

In this step, the elements of a particular level are compared with respect to a specific element in the immediate upper level. The resulting weights of the elements may be called the local weights. The opinion of respondents from different industries is elicited for comparing the elements as shown in Appendix A1. Elements are compared pairwise and judgements on comparative attractiveness of elements are captured based on Saaty's 1–9 rating scale of comparative judgements as shown in Table 5.

For this study, we requested each respondents to carefully compare a given set of factors and to rate which factor is more important in influencing sourcing complexity on contractual relationship using Saaty's 1–9 scale (where 1 = 'Equal importance', 2 = 'Equal to moderate importance', 3 = 'Moderate importance', 4 = 'Moderate to strong importance', 5 = 'Strong importance', 6 = 'Strong to very strong importance', 7 = 'Very strong or demonstrated importance', 'Very strong to extreme importance', and 9 = 'Extreme importance'). This comparison process was repeated for all criteria and their sub-criteria based on the definitions/explanations provided for each criteria/sub-criteria, to guide the respondents, as shown in Table 3. Following the completion of the questionnaire (See Appendix A2), Expert Choice software was used to perform an

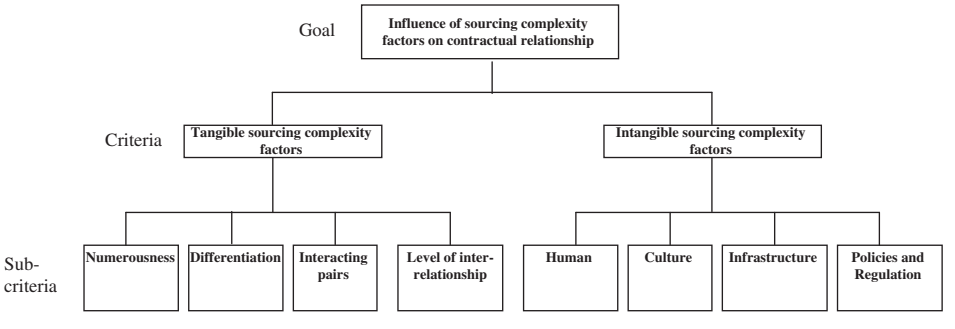


Figure 1. AHP model for sourcing complexity factors.

Table 5. Scales of comparative judgements (Saaty, 1980).

Intensity of Importance (Scale)	Definition	Explanation	Interpretation
1	Equal importance	Two activities contribute equally to the objective	*i* and *j* are equally important
3	Moderate importance	Experience and judgement slightly favour one activity over another	*i* is slightly more important than *j*
5	Strong importance	Experience and judgement strongly favour one activity over another	*i* is much more important than *j*
7	Very strong or demonstrated importance	An activity is very strongly and dominantly favoured over another with demonstrated dominance in practice	*i* is by far much more important than *j*
9	Extreme importance	One activity favoured over another with highest possible order of affirmation	*i* is absolutely/ definitely much more important than *j*
2,4,6,8	For compromise between the above values	Interpolating a compromised judgement numerically because there is no good word to describe it	Intermediate values between two adjacent judgements

individual pairwise comparison matrix for ranking the criteria with respect to the goal, and sub-criteria with respect to the criteria.

Briefly, in this step, the opinion of a decision-maker (DM), company respondent, is elicited and compared pairwise, and judgements on comparative attractiveness of elements/factors are captured using a rating scale (1–9 scale in traditional AHP). In general, an element receiving higher rating is viewed as superior (or more attractive) compared to another one that receives a lower rating. Each entry a_{ij} of the judgemental matrix are governed by the three rules: $a_{ij} > 0$; $a_{ij} = 1/a_{ji}$; and $a_{ii} = 1$ for all i. If the transitivity property holds, i.e. the $a_{ij} = a_{ik} \times a_{kj}$, for all the entries of the matrix, then the matrix is said to be consistent. If the property does not hold for all the entries, the level of inconsistency can be captured by a measure called Consistency Ratio (Saaty, 1980). A value of CR less than .1 is considered acceptable because human judgements need not be always consistent, and there may be inconsistencies introduced because of the nature of scale used. Pairwise comparisons in all our cases are within prescribed limit and they are shown in Table 6.

Step 3: Local weights and consistency of comparisons

In this step, local weights of the elements are calculated using the eigen vector method (EVM). The normalised eigen vector corresponding to the principal eigen value of the judgemental matrix provides the weights of the corresponding elements. Though EVM is followed widely in traditional AHP computations, when EVM is used, Consistency Ratio (CR) can be computed. For a consistent matrix CR = 0, and if CR for a matrix is more than .1, then judgements should be elicited once again from the decision-maker till he gives more consistent judgements.

We used Expert Choice software to calculate the local weights of the criteria and sub-criteria elements. The level of inconsistency can be captured by a measure called Consistency Ratio (Saaty, 1980). We performed sensitivity analysis (a consistency index (CI)) to measure the inconsistency of each pairwise comparison (Saaty, 1980). Our

Table 6. Weights of sourcing complexity factors.

AHP levels	Sourcing complexity factor	Weight						
		Automobile company ABC	Electronics company DEF	Food packaging company GHI	Plastics company JKL	Foot wear company MNO	Fashion company PQR	Seat company STU
Level 1	*Tangible*	*.86*	*.67*	*.83*	*.67*	*.8*	*.83*	*.83*
Level 2	Numerousness	.58	.47	.56	.32	.39	.56	.56
	Differentiation	.14	.09	.09	.16	.24	.15	.14
	Interacting pairs	.08	.06	.09	.12	.10	.08	.07
	Level of inter-relationship	.05	.07	.09	.07	.06	.06	.05
	Consistency ratio	.07	.04	.00	.04	.09	.10	.10
	Intangible	*.14*	*.33*	*.17*	*.33*	*.2*	*.17*	*.17*
	Human	.06	.14	.06	.11	.10	.07	.07
	Culture	.03	.06	.04	.11	.06	.04	.04
	Infrastructure	.03	.08	.05	.07	.02	.04	.05
	Policies and regulations	.02	.05	.02	.04	.02	.01	.01
	Consistency ratio	.08	.09	.02	.08	.09	.06	.06

analysis satisfies the minimum guidelines (CR value less than .1) and it is considered acceptable because human judgements need not be always consistent, and there may be inconsistencies introduced because of the nature of scale used. The weights of the sourcing complexity factors and consistency ratio for each company of this study are shown in Table 5.

5. Results and discussion

The final weights obtained by AHP method for the seven case companies selected for this study are shown in Table 6. The important findings from the analysis are discussed below.

The results indicate that Chinese suppliers consider tangible sourcing complexity factors as the most important in their contractual relationship with their OEM partners. On a general level, the overall weights for tangible sourcing complexities are significantly higher in each of the seven case studies compared with the overall weights for intangible sourcing complexity factors for the seven case studies (see Table 6). We discuss each category as below.

5.1. Tangible sourcing complexity category

All of the investigated companies believe that tangible sourcing complexity factors are more important than intangible factors for contractual relationship (see Table 6).

Of the tangible category, 'numerousness' (i.e. the number of suppliers, various methods and channel of supply, and number of interfaces and systems) is the dominating factor for Chinese suppliers' list of sourcing complexity factors with weighting of .58 (see Table 6). In other words, Chinese suppliers feel that the presence of too many competitors induces complexity in their contractual relationships with OEMs. This is in line with literature which suggests numerousness as a major tangible sourcing complexity factor (Choi & Krause, 2006; Fredriksson & Jonsson, 2009; Kaluza et al., 2006). The second biggest issue, after numerousness, among the seven companies investigated is 'differentiation' in technical capabilities and operational practices between OEM and the suppliers. In terms of weightage, all firms consider 'differentiation' as important with the exception of the Electronics Company DEF. As noted by Lanza et al. (2010), the state-of-the-art technological equipment and high-level automation required to achieve the desired high quality products in high-income countries simply implies some products cannot be manufactured by low-cost suppliers. The Electronics Company DEF and food packaging company GHI scored 'differentiation' as low as .09 compared with other sectors with average weightage of above .10. We believe that this low score is connected with the nature and type of product the companies produce (sensor switches and wireless remote control door bell, smoke alarm, multifunctional wireless home security alarm systems, and packaging bags). These products are generally more scrutinised for their functional effectiveness and less on their looks as they are not normally conspicuously displayed items when compared with seats, footwear, and food packaging products that depend on visual appeal to customers. The results indicates that the 'interaction' among the suppliers connected to a single OEM is considered to be only marginally important with no significant complexity impact (see Table 6).

The overall tangible weight for each industry suggests that automobile company experiences relatively higher sourcing complexity (.86) compared with the remaining industries (see Table 6). This result is not entirely surprising given the proliferation and

diverse nature of auto businesses and, therefore, the need for differentiation to meet competition. The 'food packaging (.83)', 'fashion (.83)' as well as 'seat (.83)' and 'footwear (.8)' industries show relatively similar overall tangible complexities. These may be because these products all complete on differentiation and/or variety that invariably leads to numerousness. For example, different models of an automobile require somewhat different, albeit, similar functioning parts, increasing numerousness and differentiation. The industries which experience least sourcing complexities, in terms of their overall tangible weight, are 'electronics' and 'plastics' with total tangible weight of .67. The reason for this may be due to overwhelming emphasis on human capabilities rather than hardware.

5.2. Intangible sourcing complexity category

The importance of weights pattern is similar in five industries (automobile, plastics, footwear, fashion and seat) and it decreases from maximum to minimum from four factors i.e. human, culture, infrastructure, and polices and regulation. All companies believe human aspects, such as skills, knowledge, and understanding of workforce, as important intangible factors compared to other factors such as culture, infrastructure, and policies and regulations. The remaining three industries, electronics, seat, and food packaging, have similar pattern with weights from highest to lowest weights as follows: human, infrastructure, culture, and policies and regulation. In these two industries, infrastructure factors play a dominant role than culture. These two firms believe that opacity of information, comparative price level, and demarcating supply chain as the biggest intangible complexity factor in their OEMs relationship.

Contrary to our expectation, elements of 'culture' which comprises criminality, corruption, and language differences between Chinese suppliers and OEM appeared to have no serious impact on contractual relationship. Three of the seven companies rated 'culture' as third in significance level, while the three firms rated it second among the four intangible factors. Follow-ups through phone calls to clarify the true situation regarding this finding yielded no significant difference as each company we revisited is adamant that this is not a major issue in their establishment. Another surprising finding is with 'policy and regulations' (currency, risk of supply, intellectual property risk, and dynamic customer requirements) which appear not to receive due importance from suppliers despite this factor being a major issue from OEM perspective. An interesting observation from our results is that virtually all the intangible factors, human, culture, and infrastructure are uniquely rated as significant complexity issues in electronics company DEF and plastics company JKL (see Table 6). This is due to importance of the elements such as skills, knowledge, quality issues, information sharing, and intellectual property risks. These findings are in line with literature which generally regards the factors as major issues when sourcing from China (Fredriksson & Jonsson, 2009; Lanza et al., 2010). 'Infrastructure' is seen as a major intangible complexity factor in the electronic, food packaging, fashion, and seat companies. This may be because these companies are experiencing faster changing trends that create comparative price levels, opacity of sharing information, and time zones compared with other sectors investigated.

Overall, 'Electronics and plastics' industries experience the highest intangible sourcing complexities, with overall weight of .33. As explained above, the 'Electronics and plastics' industries are the firms experiencing fastest changing trends with their associated infrastructure needs, intellectual property rights issues that leads to opacity of sharing information, and quality issues compared with other industries investigated.

Footwear company has an overall intangible weight as .2, next to electronics and plastics industries. Three industries, 'food packaging', 'fashion', and 'seat', share similar overall intangible sourcing complexity weights of .17. This result reflects the nature of human capital and skills as well as the infrastructure needed for effective functioning of these sectors compared with others. Automobile company has slightly lower intangible factors weight relative to the other industries.

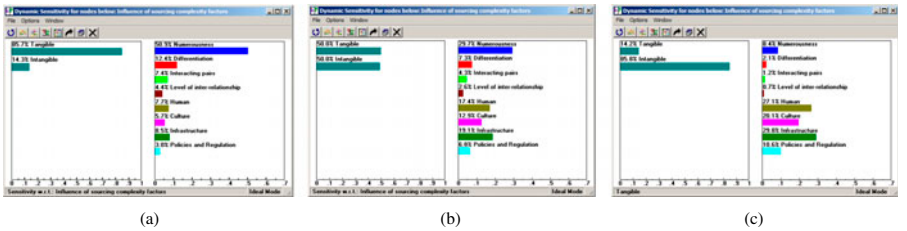
5.3. Sensitivity analysis

To classify industries based on complexity factors as well to identify the importance of various complexity factors with respect to industry context, we carried out sensitivity analysis with various scenarios. We tested the performance of the complexity factors with two scenarios. The two scenarios are: (i) equal weightage to level 1 factors, i.e. tangible and intangible factor; and (ii) reverse weightage to level 1 factors. The reasons for selecting the two scenarios are: (i) equal weightage scenario, to identify the influence of individual sub-factor under balanced conditions, which is almost idealistic; and (ii) to study the impact if the Chinese suppliers have more structured system, whereby the intangibility factors are more concern to firms than tangible factors. Figures 2–8 show the importance of each factor in two scenarios, and the following section explains the grouping of industries based on tangible and intangible factors importance pattern.

5.3.1. Equal weightage scenario

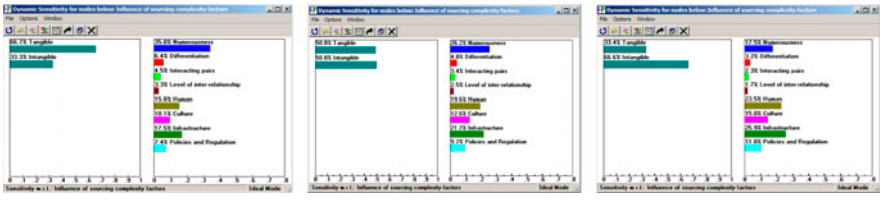
In this scenario, all the seven industries view tangibility factors in a similar pattern ranging numerousness as the most important and level of inter-relationship as the least important. It is obvious from the analysis that Chinese suppliers felt that, to reduce complexity, the buyers have to reduce the number of suppliers they are dealing with, to substantially reduce complexity. This is followed by difference in practices between supplier and buyer, number of interacting pairs with buyers, and level of inter-relationship among suppliers.

In terms of intangible factors, five companies out of seven have similar pattern. Five companies are automobile, electronics, food packaging, fashion, and seat. These companies consider human aspects as the most important aspect followed by infrastructure, culture, and policies and regulations. It is interesting to note the significance of infrastructure factors in equal weightage scenario compared to cultural aspects in the existing scenario. The role of opacity in sharing information, comparative price levels, and establishing longer supply chains increase with increase in intangible weightage, and it is the second



(a) (b) (c)

Figure 2. Automotive company sensitivity analysis charts. (a) Actual weightage, (b) equal factors weightages, and (c) reverse factor weightages.

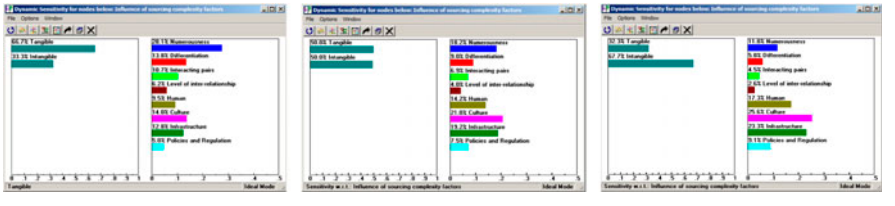


(a) (b) (c)

Figure 3. Electronics company sensitivity analysis charts. (a) Actual weightage, (b) equal factors weightages, and (c) reverse factor weightages.

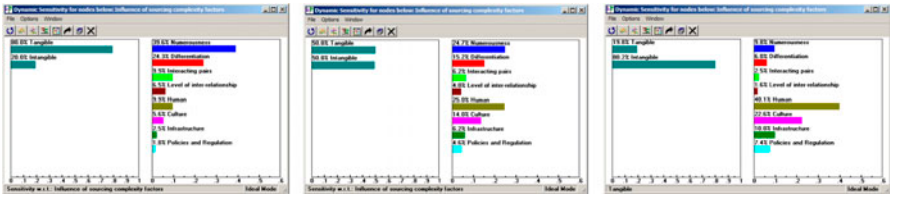
(a) (b) (c)

Figure 4. Food packaging company sensitivity analysis charts. (a) Actual weightage, (b) equal factors weightages, and (c) reverse factor weightages.



(a) (b) (c)

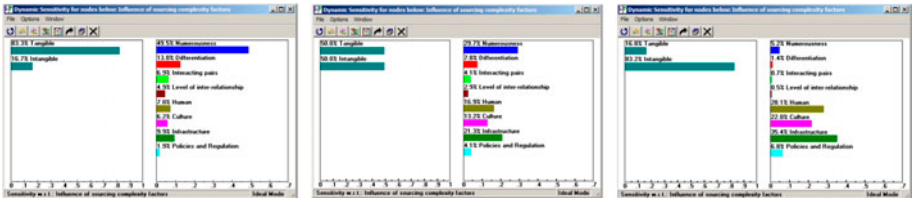
Figure 5. Plastics company sensitivity analysis charts. (a) Actual weightage, (b) equal factors weightages, and (c) reverse factor weightages.



(a) (b) (c)

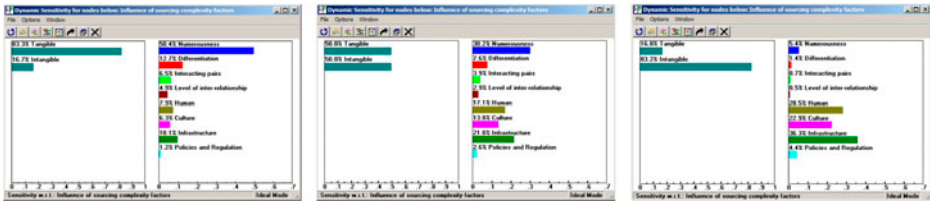
Figure 6. Footwear company sensitivity analysis charts. (a) Actual weightage, (b) equal factors weightages, and (c) reverse factor weightages.

dominant issue after human capital and most often surpasses culture factors in the existing scenario. The other two companies, plastics and footwear, have similar intangible factors



(a) (b) (c)

Figure 7. Fashion company sensitivity analysis charts. (a) Actual weightage, (b) equal factors weightages, and (c) reverse factor weightages.



(a) (b) (c)

Figure 8. Seat company sensitivity analysis charts. (a) Actual weightage, (b) equal factors weightages, and (c) reverse factor weightages.

ranking as existing scenario. The analysis clearly indicates that there is no variation in ranking of factors when tangible factors reduce from high to equal weightage scenario, whereas the ranking of factors in intangible factors varies considerably.

5.3.2. Reverse weights scenario

This scenario is applicable to the situation when the companies considerably reduce tangible complexity factors such as numerousness, differentiation, number of interacting pairs, and level of inter-relationship. The companies have to concentrate on intangible factors to deal with complexity. The analysis reveals that the pattern in tangible factors is similar to existing and equal weightage scenario. In intangible factors category, similar to equal weightage scenario, two companies, such as footwear and plastics, visualise culture as the dominating factor next to human factor. The other five companies, such as automobile, electronics, food packaging, fashion, and seat, have similar pattern like existing and equal weightage scenario.

Contribution of each tangible and intangible factor with respect to the case companies under both scenarios are discussed below

5.3.2.1 Automobile company ABC. In the automotive context, numerousness followed by differentiation in practices is dominant factors in tangible category. Especially, suppliers perceive to have less variation in lead time, landed cost, and number of suppliers. Similarly, they like to have knowledge and training to minimise variation in differentiation in practices.

In the intangible factors, category infrastructure, human, and cultural aspects plays dominant role. An automotive company feels that transparency in sharing information,

appropriate network gathering, and clearly demarcating supply chains are vital to automotive sector.

5.3.2.2. Electronics company DEF. Electronics company suppliers view numerousness as a dominating factor to reduce complexity with their buyers. Suppliers like to reduce variations in lead time, number of channels, and to have stronger relationship with few suppliers. In the intangible category, similar to automotive industry, three intangible factors, such as infrastructure, human, and cultural aspects, play dominant role. If buyers concentrate on the three intangible factors, they could almost avoid complexity to certain extent and it could lead to better collaboration in the future.

5.3.2.3. Food packaging company GHI. Food company supplier believes that reducing numerousness would ultimately reduce tangible complexity like other industries. Interestingly, in the intangible factors category, human factors have higher role than infrastructure and cultural aspects. Food company solely depends on human skills, knowledge, and understanding. Like other industries, sill infrastructure and cultural aspects have a say on complexity in food company. Buyers could mitigate complexity if they pay enough attention towards three intangible factors.

5.3.2.4. Plastics company JKL. Numerousness and differentiation in practices have bigger role from the plastic company supplier perspective in the tangible category. Role in differentiation in capability, practices, and logistics constraints are serious issues to be taken care by the multinational buyers from the Chinese suppliers. In the intangible factors category, similar to other industries, the three factors, namely cultural, infrastructure, and human factors, are the critical factors to be taken care of. Interestingly, cultural factor is the dominant factor in the intangible category. Chinese supplier agrees that multinational buyers have issues with respect corruption, criminality, quality problems, language issues, legacy aspects, patent right protection, price erosion due to increased competition, etc.

5.3.2.5. Footwear company MNO. Numerousness and differentiation factors between suppliers and buyers instigate complexity in the footwear industry. Interestingly, the impact of differentiation in capabilities, practices, and logistics constraints are significant compared to other industry. Leading buyers should focus on developing capability and devote enough resources to implement similar practices to the supplier to achieve significant profit without any hassles. In the intangible category, only human and cultural factors have significant impact on complexity and contractual relationship. Footwear industry depends on human skills, knowledge, and understanding as well as quality issues, corruption, and protection of intellectual property rights. To improve contractual relationship, multinational buyers should understand and adapt to overcome the challenges with respect to human and cultural aspects in the footwear industry.

5.3.2.6. Fashion company PQR. Supplier in fashion company agrees that numerousness issue with respect to number of suppliers, supply channel, lead time variation, and components in landed costs are various serious factors towards contractual relationship with international buyers. Next to numerousness differentiation in capabilities, practices and logistical constraints are to be taken care to improve contractual relationship. In the intangible category, three factors, namely infrastructure, human, and culture, have significant effect on contractual relationship, and the influence pattern of each factor is

somewhat similar to electronics and automotive industry. International buyers need to seek appropriate ways to take care of transparency in information sharing, demarcation of supply chains, adapting to different time zones, etc.

5.3.2.7. Seat Company STU. Both tangible and intangible factors pattern of influence on seat company from the suppliers' perspective are similar to fashion company. More or less, the priority weights are similar due to the nature of industry. International buyers need to concentrate on numerousness and differentiation in the tangible category. In the intangible category, they need to focus on infrastructure, human, and cultural factors to mitigate complexity and improve contractual relationship.

6. Conclusion

Most previous studies highlighted the benefits, motivations, and challenges of low-cost countries sourcing from OEMs' perspective. Previous studies also acknowledged sourcing complexity factors plays a vital role in contractual relationship between low-cost countries' suppliers and OEMs, mostly in western context. This study examined the influence of tangible and intangible complexity factors on sourcing contractual relationship from Chinese suppliers' perspective. Our finding revealed that tangible complexity factors are the most important, relative to intangible complexity factors. Our analysis suggests that tangible complexity factor of 'numerousness' and intangible complexity factor of 'infrastructure' plays a vital role in the governance of contractual relationship between OEMs from suppliers' perspective. Surprisingly, 'culture' factor have no serious impact on sourcing contractual relationship with OEMs from Chinese suppliers' perspective. Sensitivity analysis indicates that two companies, such as plastics and footwear, have to deal with cultural aspects influence when the weightage of intangible factors are higher than tangible factors.

Despite the in-depth nature of this study and its contribution to low-cost sourcing literature, there are few issues that warrant further investigation. We believe that large-scale empirical surveys across different Chinese cities will provide valuable insights and enable more generalisations of the findings. Future study may also benefit from the strengths of other methodologies, and especially from extended analyses on the inter-relationship among the factors considered in this study. To this end, we think the use of other methodologies such as an ANP to understand the interdependency of the factors and sub-criteria considered in this study appears warranted would be beneficial.

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Appendix A1. Pairwise comparison matrices for different industries

A1. Automotive company

Sourcing complexity factors	Tangible	Intangible	Local weight
Tangible	1	6	.857143
Intangible	–	1	.142857

Tangible factors	Numerousness	Differentiation	Interacting pairs	Level of inter-relationship	Local weight	Global weight
Numerousness	1	7	6	7	.677429	.580653
Differentiation	–	1	2	4	.165627	.141966
Interacting pairs	–	–	1	2	.098213	.084183
Level of inter-relationship	–	–	–	1	.058732	.050341

Intangible factors	Human	Culture	Infrastructure	Policies and regulations	Local weight	Global weight
Human	1	2	2	3	.423586	.060512
Culture	–	1	1	2	.227045	.032435
Infrastructure	–	–	1	2	.227045	.032435
Policies and regulations	–	–	–	1	.122325	.017475

A2. Electronics company

Sourcing complexity factors	Tangible	Intangible	Local weight
Tangible	1	2	.666667
Intangible	–	1	.333333

Tangible factors	Numerousness	Differentiation	Interacting pairs	Level of inter-relationship	Local weight	Global weight
Numerousness	1	8	8	7	.711584	.474389
Differentiation	–	1	2	2	.129358	.086238
Interacting pairs	–	–	1	2	.091658	.061105
Level of inter-relationship	–	–	–	1	.0674	.044933

Intangible factors	Human	Culture	Infrastructure	Policies and regulations	Local weight	Global weight
Human	1	2	2	3	.425784	.141928
Culture	–	1	1	1	.194547	.064849
Infrastructure	–	–	1	2	.231237	.077079
Policies and regulations	–	–	–	1	.148431	.049477

A3. Food packaging company

Sourcing complexity factors	Tangible	Intangible	Local weight
Tangible	1	5	.833333
Intangible	–	1	.166667

Tangible factors	Numerousness	Differentiation	Interacting pairs	Level of inter-relationship	Local weight	Global weight
Numerousness	1	6	6	6	.666667	.555556
Differentiation	–	1	1	1	.111111	.092593
Interacting pairs	–	–	1	1	.111111	.092593
Level of inter-relationship	–	–	–	1	.111111	.092593

Intangible factors	Human	Culture	Infrastructure	Policies and regulations	Local weight	Global weight
Human	1	2	1	4	.369569	.061595
Culture	–	1	1	2	.22351	.037252
Infrastructure	–	–	1	4	.314529	.052421
Policies and regulations	–	–	–	1	.092392	.015399

A4. Plastics company

Sourcing complexity factors	Tangible	Intangible	Local weight
Tangible	1	2	.666667
Intangible	–	1	.333333

Tangible factors	Numerousness	Differentiation	Interacting pairs	Level of inter-relationship	Local weight	Global weight
Numerousness	1	3	2	4	.477827	.318551
Differentiation	–	1	2	2	.235184	.15679
Interacting pairs	–	–	1	2	.181809	.121206
Level of inter-relationship	–	–	–	1	.10518	.07012

Intangible factors	Human	Culture	Infrastructure	Policies and regulations	Local weight	Global weight
Human	1	1	2	2	.32497	.108323
Culture	–	1	2	2	.32497	.108323
Infrastructure	–	–	1	3	.223436	.074479
Policies and regulations	–	–	–	1	.126623	.042208

A5. Footwear company

Sourcing complexity factors	Tangible	Intangible	Local weight
Tangible	1	4	.8
Intangible	0.25	1	.2

Tangible factors	Numerousness	Differentiation	Interacting pairs	Level of inter-relationship	Local weight	Global weight
Numerousness	1	3	3	4	.493458	.394767
Differentiation	–	1	4	4	.30246	.241968
Interacting pairs	–	–	1	2	.123651	.098921
Level of inter-relationship	–	–	–	1	.080431	.064345

Intangible factors	Human	Culture	Infrastructure	Policies and regulations	Local weight	Global weight
Human	1	3	4	3	.500941	.100188
Culture	–	1	3	4	.281613	.056323
Infrastructure	–	–	1	2	.124853	.024971
Policies and regulations	–	–	–	1	.092593	.018519

A6. Fashion company

Sourcing complexity factors	Tangible	Intangible	Local weight
Tangible	1	5	.833333
Intangible	–	1	.166667

Tangible factors	Numerousness	Differentiation	Interacting pairs	Level of inter-relationship	Local weight	Global weight
Numerousness	1	7	6	6	.666625	.55552
Differentiation	–	1	3	3	.174887	.145739
Interacting pairs	–	–	1	2	.092412	.07701
Level of inter-relationship	–	–	–	1	.066077	.055064

Intangible factors	Human	Culture	Infrastructure	Policies and regulations	Local weight	Global weight
Human	1	2	2	4	.423921	.070654
Culture	–	1	1	3	.230796	.038466
Infrastructure	–	–	1	5	.268467	.044745
Policies and regulations	–	–	–	1	.076815	.012803

A7. Seat company

Sourcing complexity factors	Tangible	Intangible	Local weight
Tangible	1	5	.833333
Intangible	–	1	.166667

Tangible factors	Numerousness	Differentiation	Interacting pairs	Level of inter-relationship	Local weight	Global weight
Numerousness	1	7	7	6	.676249	.563541
Differentiation	–	1	3	3	.170733	.142277
Interacting pairs	–	–	1	2	.087459	.072882
Level of inter-relationship	–	–	–	1	.065559	.054633

Intangible factors	Human	Culture	Infrastructure	Policies and regulations	Local weight	Global weight
Human	1	2	2	6	.432107	.072018
Culture	–	1	1	5	.240545	.040091
Infrastructure	–	–	1	8	.277283	.046214
Policies and regulations	–	–	–	1	.050065	.008344

Appendix A2. Pairwise comparison questionnaire (Please answer all questions by using the Saaty scale between 1 and 9, as explained)

Complexity factors in contractual relationship

Q1: Influence of sourcing complexity factors on contractual relationship according to your view which factor between tangible and intangible is more important? And to what extent (Please use scale between 1 and 9).

Tangible sourcing complexity factors

Q2: Influence of tangible sourcing complexity factors on contractual relationship according to your view which factor (between numerousness and differentiation) is more important?

Q3: Influence of tangible sourcing complexity factors on contractual relationship according to your view which factor (between numerousness and interacting pair) is more important?

Q4: Influence of tangible sourcing complexity factors on contractual relationship according to your view which factor (between numerousness and level of inter-relationship) is more important?

Q5: Influence of tangible sourcing complexity factors on contractual relationship according to your view which factor (between differentiation and interacting pairs) is more important?

Q6: Influence of tangible sourcing complexity factors on contractual relationship according to your view which factor (between differentiation and level of inter-relationship) is more important?

Q7: Influence of tangible sourcing complexity factors on contractual relationship according to your view which factor (between interacting pairs and level of inter-relationship) is more important?

Intangible sourcing complexity factors

Q8: Influence of intangible sourcing complexity factors on contractual relationship according to your view which factor (between human and culture) is more important?

Q9: Influence of intangible sourcing complexity factors on contractual relationship according to your view which factor (between human and infrastructure) is more important?

Q10: Influence of intangible sourcing complexity factors on contractual relationship according to your view which factor (between human and policies and regulations) is more important?

Q11: Influence of intangible sourcing complexity factors on contractual relationship according to your view which factor (between culture and infrastructure) is more important?

Q12: Influence of intangible sourcing complexity factors on contractual relationship according to your view which factor (between culture and policies and regulations) is more important?

Q13: Influence of intangible sourcing complexity factors on contractual relationship according to your view which factor (between infrastructure and policies and regulation) is more important

Open-ended questions

Q14: Any other comments on the Influence of tangible and intangible sourcing complexity factors on contractual relationship:

Q15: Any other general comment: